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Second Annual Report for Research Project

Analysis of Capital Formation  
and Technological Innovation  
at the Farm Level in LDC's

by  
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Columbus, Ohio

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## FOREWORD

The Department of Agricultural Economics and Rural Sociology of The Ohio State University entered into subject contract on July 1, 1969, to analyze the interrelationship at the farm level between capital formation, technological change, and growth of agricultural output in selected less-developed countries. The project is designed for a period of five years. The present report covers operations under this contract for the period July 1 to June 30, 1971.

The project has two primary objectives: (1) investigate and describe capital formation and utilization at the farm level including the impact of technological change on the need for capital and on the capital formation process, (2) evaluate the implications and impact of selected policies designed to stimulate capital formation. The plan of work calls for an extensive farm-level data collection effort to be mounted in southern Brazil during the first two years of the contract. Data are to be collected from a sufficiently large cross section of farms so that homogeneous farm groups can be identified, reflecting the farm characteristics of size, type, technology, tenure, market orientation, management level, and power use. The contractor is to cooperate with host government institutions in conducting this field research.

Project activities were initiated in Brazil in November of 1969 in cooperation with the USAID Mission to Brazil, the Central Bank of Brazil, and two Brazilian universities. An initial field research effort was completed in January and February of 1970. Additional field research in

cooperation with two other Brazilian universities was completed in July of 1970. Supplementary rural infrastructure studies were undertaken early in 1971. The four universities are: the Federal University of Rio Grande do Sul, in Porto Alegre in the state of Rio Grande do Sul; the Federal University of Santa Catarina, in Florianopolis in the state of Santa Catarina; the University of São Paulo, at Piracicaba in the state of São Paulo; and the Federal University of Vicosa, at Vicosa in the state of Minas Gerais.

Several individual studies have progressed to the analysis and write up stage. Progress statements on each are included as part of this report. A publication series entitled "Research Notes" was initiated this year. These notes are short statements of preliminary findings of a continuing research project and serve as a communication vehicle to achieve early dissemination of significant findings and to gain feedback from other researchers while the project analysis is still underway. Eight research notes have been published this year, and are available upon request. A list of titles is included with this report. The administrative report on this project, including expenditures and personnel employed under the contract is submitted separately.

## FIELD WORK IN BRAZIL

The contract conducted field interviewing in three southern and central states of Brazil during the period January 1, 1970 to June 30, 1971. A brief description of this effort follows.

### Rio Grande do Sul

Field interviewing in the state of Rio Grande do Sul has been carried out in two steps. The first and largest field interviewing activity took place in January and February of 1970. A total of 370 farm-level interviews were conducted in three counties. The counties are Lajeado, Carazinho, and Nao-Me-Toque. Two of the areas, Carazinho and Lajeado, had been interviewed previously in 1965. Many of the farmers interviewed in 1965 were re-interviewed in 1970. The data from the 370 farms has been coded, punched, and is now being analyzed. A preliminary report of over 100 pages was prepared in Portuguese and distributed in December of 1970.

In July, 1970, contract personnel in conjunction with the Federal University of Rio Grande do Sul interviewed 171 farmers in the municipio of São Borja located on the western border of the state adjacent to Argentina. This municipio has been profoundly influenced by governmental policies which have rapidly stimulated wheat production. The objective for the interviewing was to obtain data on the transformations occurring at the farm level because of the shift from traditional cattle raising to mechanized, highly capital extensive wheat growing. This data will be analyzed for the resulting change in resource use, farm income, and capital formation potential. The data has been placed on cards, and data analysis is underway. A descriptive report of this fieldwork is being prepared in Portuguese.

During February, 1971, a second stage of data collection in the municipio of São Borja was undertaken. This field work was part of a larger study including the municipios of Lajeado, Carazinho, and Não-Me-Toque where farm interviews were obtained during January and February, 1970. This second stage had the principle objective of identifying the extent to which increased wheat production had stimulated transformations in input and product markets in rural communities. Fifty-five interviews were conducted with agronomists, bankers, mayors, and input and product dealers.

Through these interviews at both the farm and rural community level, it is expected that conclusions will be obtained regarding the overall impact of Brazilian policies designed to stimulate domestic wheat production and reduce imports.

#### Santa Catarina

Field interviewing in the state of Santa Catarina was conducted in January and February of 1970. A total of 370 farm-level interviews were undertaken in three municipios. Again, as in Rio Grande do Sul, farmers in two of the municipios had been interviewed in 1965 and were re-interviewed in 1970. These municipios are Concordia and Timbo. A third municipio, Turvo, was interviewed for the first time. Turvo is characterized by the production of rice and corn and has recently undergone a shift to mechanization on many farms in the area. The data from the three municipios has been coded, put on cards, and is now being analyzed.

#### São Paulo

Farm interviews were taken in the state of São Paulo during July, 1970, in conjunction with the Department of Applied Social Sciences,

Agricultural School "Luiz de Queiróz", University of São Paulo. A total of 383 farm level interviews were undertaken in 10 municípios in the Ribeirão Preto area located in the northern part of the state. This is an important agricultural region of the state with coffee, sugar-cane, annual crops (corn, soybeans, cotton, and rice), dairy and beef cattle being predominant.

Within the overall region, municípios were selected for study on the basis of concentration in the production of one or more of these commodities. The sample was stratified into three size strata based on the Agrarian Reform Institute property rolls, and farmers specialized in the commodity of interest in the município were randomly selected for interviewing. This data has been coded, some preliminary analyses have been completed and reported in research notes, and more detailed studies are underway.

A second stage of data collection was also undertaken in these municípios. Over 60 interviews were conducted with mayors, agronomists, statistical agents, and fertilizer dealers. The objectives of this field work were to obtain general background data about the region, and study the functioning of the fertilizer distribution system and its effect on fertilizer use at the farm level. This data has been put on cards and some preliminary results reported in a research note. A general descriptive report of both these stages of field work is now being prepared in Portuguese.

#### Minas Gerais

The third major focus of field work during July, 1970 was located in the state of Minas Gerais where 277 farm-level interviews were conducted in collaboration with the Institute of Rural Economics, Federal University of Vicosa. Three general areas were included in this field work: the first was the município of Muriaé, located in the mountainous eastern region

known as Zona da Mata; the second was in Capinópolis, one of the most mechanized regions of the state; the third was Uberaba, a cattle raising area located almost directly north of the area in São Paulo where cattle growers were interviewed. The latter two municípios are in the Minas Triangle, the richest area of the state where topography and farm size facilitate higher levels of mechanization than found elsewhere. The Zona da Mata is one of the old coffee growing areas which has been depressed because of a coffee decline during the last decade. Farms are small and production is largely subsistence. A opportunity may exist for studying farm decapitalization in this region, rather than capital formation.

#### Progress Report to USAID/Brazil

A briefing session concerning the work performed under the project was held at USAID in Rio for all interested USAID personnel. The briefing session was conducted by four members of the research project -- Norman Rask, Dale Adams, Richard Meyer, and Bill Nelson. The USAID personnel attending consisted of Harlan Davis, Stanley Krauss, and David Cohen. William Rodgers, Chief, ARDO, and Ralph Miller attended parts of the session. The presentation by project personnel was structured around the following topics. First, a brief review of the general project



objective, and the plan of work was given. This was followed by a rather detailed discussion of the field research activities in Brazil, including the areas surveyed, interviews completed, and the degree of involvement of local institutions.

Third, a brief discussion of specific research projects was presented, including an outline of the analysis techniques being followed and some preliminary results. This discussion focused around three general topics: 1) studies looking at the capital formation process, 2) specific studies on technology with special emphasis on mechanization and fertilizer, and 3) studies focusing on credit savings.

Following the presentation of work completed and in progress, the discussion turned to future research possibilities in Brazil. A major part of this presentation focused on a proposed study of the Brazilian wheat programs and the resulting impact at the farm level, and on a proposed cattle study in various areas of Brazil.

The meeting concluded with a presentation by USAID/Brazil concerning their specific research interests and the manner in which research performed under the project could be integrated with the needs of USAID/Brazil and the Brazilian host institutions. A summarization of the results of the briefing session and subsequent discussions follow:

- 1) USAID was interested in the type of research undertaken by the project, and in the approach followed in the selection of topics and areas to be studied.
- 2) USAID indicated an interest in receiving short, periodic, non-technical statements from the research personnel concerning provisional findings of our research effort. It was agreed that the project would prepare a series of "research notes" to be forwarded to interested people. These would be in the form of non-technical

papers prepared in advance of final results and designed primarily to acquaint interested people with the general thrust of our analysis and some of the preliminary results.

- 3) As a further means of communicating research results as well as soliciting suggestions for additional research topics, the possibility of conducting a joint Brazilian, USAID/Brazil, and project seminar within the next eight to ten months was discussed. The idea was generally accepted and Richard Meyer of the project and Harlan Davis of USAID/Brazil were to explore the possibility further and suggest definite plans for holding a seminar. Probable time for the seminar was set for September, 1971.
- 4) USAID indicated that the major emphasis on their agricultural programs in the coming months and years would be in the Northeast area of Brazil. Consequently, they encouraged the project personnel to undertake a trip to Recife to investigate the possibility of locating part of the project activities in the Northeast in conjunction with the on-going USAID program.
- 5) USAID also indicated that they were gradually moving the center of their administrative activities from Rio de Janeiro to Brasilia. They encouraged us to visit the Ministry of Agriculture in Brasilia to ascertain Brazilian priorities for agricultural development. They felt it imperative that we also focus on problems important to the Brazilians.

Visits were made to Recife and to Brasilia as a consequence of these discussions and the results of these visits are reported separately below:

Possibilities for Locating Part of Project Activities  
in Northeast Brazil

We were strongly encouraged by USAID/Rio to locate part of our research activities in the Northeast of Brazil in conjunction with their agricultural development program. Further, on our arrival in Recife we again received strong encouragement to locate personnel and project activities in the Northeast. Several days were spent discussing possible project involvement with USAID personnel in the Northeast and with the two principal Brazilian institutions working on development problems there -- SUDENE and The Bank of the Northeast.

Throughout these discussions only one program was identified that would clearly fit into the framework of our project emphasis and at the same time had been in operation long enough to lend itself to evaluation. This was a project administered by SUDENE and related to tax incentive programs for increasing cattle production. However, on a national basis this program had acquired considerably more visibility in the states of Goais and Mato Grosso which are technically not administered through the Northeast programs. A minor area in the state of Minas Gerais was administered by SUDENE and would lend itself to program evaluation; however, this could be more easily handled from the project operations now located in Piracicaba. Therefore, it was the consensus of the group that before making any major research commitments in the Northeast it was necessary to wait for both AID and Brazil institutions to initiate specific development programs.

It was also decided that at a later date Richard Meyer of the project staff and Harlan Davis of USAID/Brazil would visit The Bank of the Northeast and the University of Ceara in the city of Fortaleza to investigate further possible research involvement in the Northeast.

Research Interest of Brazilian Institutions  
at the National Level

The Ministry of Agriculture is in the process of changing its posture relative to development planning in Brazil. Previously, it was largely concerned with research and extension activities at the state and local level. They are now developing a planning and policy-making capability within the Ministry at the national level (SUPLAN). Consequently, USAID was interested in having project personnel counsel with them concerning Brazilian research priorities and to ascertain the manner in which research carried out under the Capital Formation Project might benefit their (Brazilian) planning activities. The results of meetings with the Ministry people in Brasilia has been reported previously in a letter from Richard Meyer to William Rodgers under date of November 25, 1970.

Briefly, areas of specific interest to the Ministry were wheat, pricing policy, cattle development programs, and agricultural credit. They were not in a position to be more specific at this time.

At the present stage of development of this new thrust in the area of national planning by the Ministry of Agriculture, we suggested that our project could be helpful in the following ways:

- (1) Provide them with preliminary and final conclusions derived from our research with special emphasis on the three above-mentioned issues.
- (2) Make available the data already generated by our field work to the Ministry students studying in the Brazilian institutions with whom we are working, and assist them to use it for their theses or other research papers of interest to the Ministry.

- (3) Help to identify Brazilians at these institutions who might be potential staff members for the Ministry.
- (4) Offer training opportunities at Ohio State University for members of the new staff.

#### Summary and Future Plans

The field work programmed for calendar year 1970 has been accomplished and the data processing and early analysis activities are in progress. With a large volume of primary data in hand and a considerable task of data analysis yet to be done, it was decided not to engage in further major primary data collection activities until July of 1971.

Major policy programs to increase the level of agricultural productivity in Brazil have largely focused in the areas of price support, credit, and input subsidization. Program emphasis has been largely centered in the areas of fertilizer, mechanization, production loans for basic food crops, and high wheat support prices. Some recent efforts have attempted to stimulate cattle production. These programs have largely affected the central and southern parts of Brazil. There is no massive impact program for the North or Northeast. Also, the Brazilians expressed interest in additional studies of wheat, cattle, and credit programs.

In response to these major program thrusts and within the framework of the research project, analytical studies in the areas of mechanization, fertilizer and credit have already been initiated. Based on discussions with USAID, Brazilian institutions and consistent with the interests of USAID/Washington to concentrate on studying the impact of major policy programs, two additional studies are being added. The first

is a study of Brazil's attempt to become self-sufficient in wheat production, including a documentation and quantification of various incentive programs that have stimulated farmers to increase the acreage devoted to the production of wheat. These include mechanization, fertilizer subsidization, price support programs, and subsidized interest rates for operating loans.

To carry out this wheat project some additional data gathering was undertaken in January at the community and national level. Farm-level interviews conducted in the state of Rio Grande do Sul in January and July of 1970 adequately represent the wheat producing areas so additional farm-level interviewing is not contemplated.

The second study being considered deals with the stimulation of cattle production. This study will include all major agricultural production areas in Brazil. Farm-level data has already been collected in the states of Rio Grande do Sul, São Paulo, and Minas Gerais. Additional data collection is contemplated in the areas that have increased cattle production as a result of tax incentive programs. This study will be initiated in 1971.

Analytical studies concerned with the use of credit under a wide variety of farm situations will be continued with special emphasis on the credit problems of small farmers. Additional field research in this area is also planned for July, 1971.

#### Personnel Assignments

William Nelson - Mr. Nelson completed his assignment in Brazil at the end of January, 1971, and returned to Columbus for final analysis

and write-up of his fertilizer study.

Gerald Nehman - Mr. Nehman replaced Bill Nelson at Piracicaba in March of 1971 and will work in the area of small farmers and credit.

John Stitzlein - Mr. Stitzlein completed his assignment with one additional period of data gathering in the month of February and returned to Columbus in May of 1971 for final analysis and write-up of his project on mechanization.

Iby Pedroso - Mr. Pedroso, a Brazilian staff member at the Agricultural School in Piracicaba, and a Ph.D. candidate at OSU, has temporarily interrupted his graduate program to accept a position with the new planning agency (SUPLAN) in the Ministry of Agriculture.

#### INSTITUTIONAL LINKAGES AND USE OF DATA

The strategy adopted by the contract has been to conduct research in conjunction with Brazilian educational institutions. Two reasons are responsible for this approach. First, the level of manpower which the contract was permitted in Brazil was insufficient to directly staff a research program of the dimensions envisioned. Secondly, by working with Brazilian institutions, it was expected that their research programs and capacities would be strengthened and that their commitment to data collection would stimulate subsequent use of the data by Brazilian university faculty and students. Therefore, in all field surveys, a copy of the questionnaires and data cards is retained by the cooperating institution.

In order to use university students as interviewers, it is necessary to plan field work for holiday periods. The agricultural year in southern Brazil extends from August to July, so with questionnaires that require recall of events for the entire year, it is preferable to interview during the short holiday period of the month of July. Given the large number of observations desired, a large research team must be organized. For example, in the case of the São Paulo interviewing in July, 1970, a total of approximately 60 people were involved. These included agronomists and extension personnel that helped with selection of the municípios, 18 graduate and undergraduate interviewers, 5 Brazilian and American professionals working as supervisors, local agronomists that helped with contacting sampled farmers, drivers, coders, and secretaries. It was estimated that approximately 1430 man-days of labor were used from the time the project was conceived through data coding.



Each of the various stages of data collection and manipulation has involved Brazilians, and has required some type of training to bring personnel to desired levels of competence. Interviewers and coders usually were completely inexperienced and required considerable orientation and constant supervision. The secondary effects of this training have already been felt as some of these people have been subsequently employed in positions of responsibility in other research projects. The basic capital formation questionnaire was modified for use in another farm survey in São Paulo, and the code provided background for other projects. Both have been used in classroom presentations in São Paulo.

The data is being used by faculty and students both in OSU and each of the cooperating institutions. To date eight research notes have been prepared reporting on preliminary results of analysis. English versions are distributed within the States and to the AID Mission in Rio. The Mission distributes 50 copies within the agency and to Brazilian public agencies with which it collaborates.

The Department of Applied Social Sciences in São Paulo has undertaken the translation of these notes and is distributing over 400 copies to all members of the school faculty, all economics departments in the country, major private and public banks, and state and federal agencies. Fifty copies are provided USAID for its distribution. Almost 30 responses were received after the first mailing congratulating the department on its initiative. Two research topics were suggested by persons interested in the topics covered by the research notes.

Each of the cooperating institutions is preparing a descriptive summary of field work including some preliminary results which will be distributed to Brazilian agencies and to leaders in the municípios where the data was

collected. This is being done to recognize the cooperation received during data collection.

Several research projects are in progress or being planned by Brazilian faculty and students. For example, a former faculty member at São Paulo currently employed by the Ministry of Agriculture is working with the data on a Ph.D. thesis for presentation at OSU. A livre-docente thesis (the highest degree granted at the University of São Paulo) is being planned by another faculty member. Six M.S. students in São Paulo are working on theses using the data, and three of these are being advised by two OSU staff members in residence at the institution. Finally, some of the data is being used by a graduate level marketing course in São Paulo for a class project which represents the first time that the school computer is employed for instructional purposes other than in a computer programming course. In all these cases, encouragement is being given to widespread distribution of the results in the country. Similar levels of involvement and data use are evident at the other Brazilian universities.

Another media for potential use of research results is currently being discussed with the USAID Mission and the Ministry of Agriculture in Brazil. A seminar is planned in Brazil to present and discuss research findings with representatives from public agencies and universities. Brazilians and Americans that have research results to report will be invited to make presentations, and the participants will be asked to comment on the implications of the findings including suggestions for emphasis of future research efforts. This seminar will be sponsored by the Ministry of Agriculture and will provide a vehicle for direct input of project results to policy formulations.

## ON-CAMPUS ACTIVITIES

Project activities in the Department of Agricultural Economics and Rural Sociology at The Ohio State University have been principally concerned with the initiation of a number of individual research studies, utilizing the data collected in Brazil during 1965 and 1970. A project review was held on campus in September. Two new "team approach" projects were initiated and additional time was devoted to a further refinement and conceptualization of the capital formation process in agriculture. Final plans are being initiated for an extension of project activities to include field studies in India during the third year of the project. Each of these activities is reported below:

### Project Review

On September 11, 1970, a project review was held by AID at Columbus, Ohio. This review was attended by Erven Long, Arthur Coutu, and Lawrence Witt of AID, and Vernon Ruttan and Everett Hagan of the Research Advisory Committee. The objectives of the original contract and methodology pursued in early research work were discussed and evaluated in view of present AID objectives. The meeting and subsequent discussions were very useful to OSU in developing plans for continued work on the project. As a result of this session, an effort was undertaken to expand and further define the conceptualization of the capital formation and technological innovation process in agriculture, including its interrelationship with other sectors of the economy. Also, the timetable for initiating work on a limited sector model was advanced in order to begin immediately in this area.

### A Statement on Rural Capital Formation and Technological Change

As an outgrowth of discussions held during the September Review, it was decided to prepare a formal statement concerning the capital formation process in agriculture, including the interrelationship between capital and technology. The objective in preparing this statement was to assist AID and the project to determine research and program priorities.

Very little research has been conducted on the process of farm-level-capital-formation, and little is known about the specific impact of agricultural policies. The essence of the present project is to provide a fuller understanding of the capital formation process at the farm and community levels, and lay the base for later studies that will tie together the capital formation and capital transfer processes between sectors of developing economies. Dale Adams prepared the resulting statement, "Rural Capital Formation and Technology: Concepts and Research Issues," copies of which are available on request.

### A Research Program in India

Dr. S. S. Johl, Professor and Head of the Department of Economics and Sociology, Punjab University, India is presently serving as a visiting professor at OSU.

Dr. Johl's visit to Ohio State is part of a forward planning effort to develop a research plan for carrying out project activities in India. This research program will compliment the Brazil component of the project in both subject matter and organization. That is, research topics that need replication in different economic, social and physical environments will be repeated in the Indian context. Also, some aspects of the research map that are not researchable in Brazil will be attempted in India.

Dr. Johl will return to India, during the latter part of 1971.  
Project activities are planned for resumption in July of 1972.

PROGRESS REPORTS ON ON GOING RESEARCH PROJECTS

PROJECT NO. 1

TITLE: "An Economic Analysis of the Farm Level Factors  
Related to the Utilization of Fertilizer in  
Southern Brazil"

STATUS: Analysis and draft

TENTATIVE COMPLETION DATE: August 31, 1971

PUBLICATIONS:

Research Notes

No. 1, Nelson, William C., Fertilizer - Brazil, 1970.

No. 2, Nelson, William C., Credit & Fertilizer - Brazil  
December, 1970.

No. 3, Nelson, William C., Fertilizer Marketing - Brazil  
January, 1971

PRINCIPLE INVESTIGATORS: William C. Nelson and  
Dale W Adams

PROGRESS REPORT:

The major objective of this research is to determine the factors which have stimulated farm operators to increase their use of fertilizer in Southern Brazil. The specific factors analyzed are: (1) the economic environment which includes product and input prices; credit availability and interest rates, and liquidity levels; (2) the infrastructure which consists of credit facilities, dealer services and extension services; and (3) the management levels as measured by experience, education, social interaction and adoption of improved practices. Secondary objectives are to determine the crop response to fertilizer and optimum levels of fertilization, and to relate the consumption of fertilizer to capital formation on the farm.

This study is based on 173 of 383 farm interviews which were

PROJECT NO. 2

TITLE: "Economics of Agricultural Mechanization in  
Southern Brazil"

STATUS: data analysis

TENTATIVE COMPLETION DATE: October/November, 1971

PUBLICATIONS:

Stitzlein, John, Agricultural Mechanization - Southern  
Brazil, Research Note #4 - The Ohio State  
University - March, 1971.

Souza, Eli de Moraes, John Stitzlein, et. al., "Formacao  
de Capital e Mudancas Tecnologicas ao Nivel de  
Empresas Rurais -- Lajeado, Carazinho, e Nao-me-  
Toque - RS," Relatorio Descritivo (Preliminary  
report), 1970. IEPE/UFRGS, Porto Alegre, Brazil.

Souza, Eli de Moraes, John Stitzlein, et.al., "Formacao de  
Capital e Mudancas Tecnologicas ao Nivel de Empresas  
Rurais -- São Borja - RS," Relatorio Descritivo  
(Preliminary report), 1970. IEPE/UFRGS, Porto Alegre.

PRINCIPLE INVESTIGATORS: John Stitzlein and  
Norman Rask

#### PROGRESS REPORT:

The objective of the study is to assess some of the socio-economic consequences that appear to be associated with agricultural mechanization in developing countries. Specifically, the analysis is directed toward clarifying the relationships existing between mechanization and (1) total production, (2) labor productivity and labor usage, (3) per unit production costs, and (4) external financing requirements.

Farm survey data from four municipios (counties) in southern Brazil provide the primary bases for the analysis. The observations are nearly equally divided according to tractor ownership within each of the municipios, and depict or characterize three general but somewhat different situations. The first is one wherein mechanization has been accompanied by size increases in family farms generally engaged in both crop and livestock production; in the second, enterprise change has been the

carried out in July, 1970. The interviewing was done in the municipios of Guaira, Jardinopolis and Sales de Oliveira (annual crops), Sertaozinho and Pontal (sugar cane), Altinopolis and Batatais (coffee), and Barretos and Columbia (beef cattle). All municipios are located in the region of Ribeirao Preto in the extreme northeastern portion of São Paulo.

Preliminary findings indicate a widespread utilization of chemical fertilizers on annual crops during the 1969/70 agricultural year when 97 percent of the sample farmers applied fertilizers. However, only 45 percent of the farmers analyzed their soils, only 60 percent applied lime, and rate of fertilizer application was less than 50 percent of the recommended rates.

Usage of credit for fertilizer purchases increased from 20 percent of the farmers in 1960/61 to 65 percent in 1969/70. Bank credit, at subsidized rates, was not distributed evenly. Small farms, 10 to 30 hectares, obtained only 38 percent of their total credit for fertilizer from banks as compared to 78 percent for medium size farmers, 31 to 200 hectares, and 89 percent for large farmers, 201 to 3000 hectares.

In a survey of sixteen fertilizer dealers in the region, price differentials of 20 to 40 percent were found for identical fertilizers. Also the number of different formulas offered for sale, 74, appears to be excessive. Soil analysis services were offered by 40 percent of the dealers and credit by 90 percent. Repayment periods varied from two months to one year and the interest charge ranged from zero to three percent per month. The marketing situation is very dynamic as almost 50 percent of the dealers had less than four years of experience and many of the market imperfections may disappear as the marketing system stabilizes itself.



predominant modification coupled with mechanization as tracts of grazing land are brought into crop production; and in the third, neither a change in farm enterprise nor size appears to ensue the adoption of mechanization on smaller partially irrigated farms producing crops and livestock.

Preliminary findings coming from the Carazinho-Nao Me Toque observations (those most closely characterizing the first situation) partially indicate some of the effects agricultural mechanization may have. With respect to its effect on labor, the findings suggest that these two inputs need not be substitutes. Farmers owning tractors were employing up to twice as much labor as the non-tractor owners operating farms of comparable size. Mechanization and total production appear to be related positively; the product of the mechanized farmers exceeded that of the non-mechanized farmers by 70 to 450 percent within comparable size groups. The tractor owners employ much larger quantities of capital; their non-real estate investments generally about doubled those of the non-tractor owners, and the average amount of credit granted per farm was from two to more than 100 times greater for the mechanized as compared to the similar sized non-mechanized farmers. The larger quantities of labor and capital being employed by the mechanized farmers is suggestive of the more intense cultural practices followed and in turn is consistent with the larger total product.

PROJECT NO. 3

TITLE: Brazil's Program for Increased Self-sufficiency in Wheat

STATUS: Data preparation and analysis

TENTATIVE COMPLETION DATE: January, 1972

PUBLICATIONS:

Meyer, Richard L., and Donald Larson, Brazil's Program for Increasing Wheat Production - The Ohio State University Research Note No. 7, May, 1971.

PRINCIPLE INVESTIGATORS: Norman Rask and Richard Meyer

PROGRESS REPORT:

In 1962 and 1963, Brazil began initiating a set of policy instruments and programs designed to stimulate domestic wheat production in order to reduce its reliance on foreign supplies. The outcome has been a large increase in production, especially in recent years, and the country has now reached a point of producing over 50 percent of domestic consumption. Individual farms have undergone a series of transformations as farmers initiated and specialized in wheat growing. Community-level infrastructure has expanded as agri-businesses responded to the increased demand for inputs and services, and the public sector attempted to provide associated public services. Entire municipios in four or five years have been transformed from quiet pastoral activities to the bustle associated with wheat farming.

The key to this growth has been the creation of an assured wheat market with subsidized domestic prices. This direct price subsidy and other programs such as subsidized credit have constituted a substantial capital transfer from the non-agricultural to the agricultural sectors.

Brazil's experience with wheat is an interesting case study for analysis for several reasons. First, it is a successful example of how

manipulation of price and credit policies has stimulated a rapid expansion in output of a specific commodity. In the process, farmers have rapidly adopted new technology in the form of purchased inputs, fertilizer, and mechanization. The speed of adoption has been so rapid as to create readily identifiable secondary effects such as the amount and variety of inputs and services provided in rural communities. Secondly, these policies have resulted in an effective intersectoral capital flow which merits evaluation both in terms of the benefits derived and applicability to other situations and commodities. Finally, this is a domestic program lacking any kind of direct foreign assistance and, therefore, may have implications for other developing countries.

This study will trace the evolution of this wheat program, describe the salient factors contributing to its success, identify and quantify, when possible, the most important direct and indirect program costs, and measure the effects on farms, agri-businesses, and rural communities. The final phase of this study will explore future possibilities and consequences for wheat production of price changes and basic research on the development of new varieties.

A central consideration of this study will be the on-farm capital formation and transformation process that has accompanied the farm-level response to the program incentives. The initial thrust of the Recursive Linear Programming model project reported below and a price sensitivity analysis study of wheat and cattle farms in Rio Grande do Sul will be complementary activities to the general wheat study.

PROJECT NO. 4

TITLE: "Alternative Enterprise Combinations under Various Price Policies on Wheat and Cattle Farms in Southern Brazil"

STATUS: Initial Phase completed - followup work continuing as part of wheat study

COMPLETION DATE: June, 1971

PUBLICATIONS:

Engler, Joaquim J. de C., I. J. Singh, "Production Response to Technological and Price Changes: A Study of Wheat and Cattle Farming in Southern Brazil," The Ohio State University, Occasional Paper No. 33, June, 1971.

Engler, Joaquim J. de C., "Alternative Enterprise Combinations under Various Price Policies on Wheat and Cattle Farms in Southern Brazil," Ph.D. Thesis, Dept. of Agri. Economics and Rur. Soc., The Ohio State University, 1971.

PRINCIPLE INVESTIGATORS: Joaquim J. de C. Engler and  
John H. Sitterley

PROGRESS REPORT:

The purpose of this study is to analyze the impact of various price policies on the production of wheat and competing farm outputs in Southern Brazil. This is done explicitly with the help of a programming model that includes alternative production technologies and is formulated to simulate the impact of varying prices and resource availabilities.

The importance of such a study is twofold. First, the region under consideration is among the few areas in the world that have seen a tremendous increase in total agricultural productive capacity (i.e. agricultural capital formation) and the resultant increases in total output and productivity.\*\* This has come about through rapid mechanization, changes in cropping patterns, and increases in the use of non-farm inputs such as fertilizers, seeds and credit. Second, and the greater topical importance of the study lies in the need to analyze the impact of these new technologies

in the context of the Brazilian program to increase self-sufficiency in wheat. The program initiated in 1962/63 centers around a government policy to purchase wheat at a fixed price assured to stimulate production and stabilize the market for wheat. As wheat production has become relatively profitable, farmers have shifted out of the traditional extensive livestock enterprises to the intensive cultivation of wheat.

In view of the increased availability and adoption of new technologies, and the goal on the part of the Brazilian government, to reduce the level of domestic wheat prices in the long run, the relevant policy questions that this study attempts to ask are:

What would be the impact on production, resource use and adoption of new technologies of:

- 1) Changes in the domestic price of wheat?
- 2) Changes in the relative price of other outputs, particularly beef?
- 3) Changes in the interest rates on credit for modern inputs?

Analysis on the initial phase of this study support the following conclusions:

- 1) At current support prices (approximately \$110. per metric ton) an intensive double cropping pattern with wheat followed by soybeans is the most profitable and it can be expected that at these price levels a transition from extensive livestock production to intensive double cropping will continue, at current levels of productivity.
- 2) A reduction in the domestic support price of wheat to the world price level will make it unprofitable for

both current wheat producers in the short run and current and potential wheat producers in the long run to produce wheat.

- 3) Although wheat prices can be reduced between 35-40% in the short run and between 15-20% in the long run without affecting the production of wheat, such changes would substantially reduce the net returns per hectare and the farm incomes of current and potential wheat producers.
- 4) Unless beef productivity is raised by conversion to improved pasture it cannot compete successfully with a wheat-soybean double cropping system, even when support prices decline. In the case of productivity increases a regional transition from extensive livestock production to production with improved winter and summer pasture can be expected.
- 5) Increasing the relative price of beef without increasing beef yields would require increases in the range of 250-300% before beef becomes a competitive enterprise. Such price increases would require a domestic price support program several times as costly as the current wheat program.
- 6) The double cropping of wheat and soybeans that is currently most profitable results in a high degree of seasonality in the demand for labor, leading to both seasonal unemployment and scarcity. A shift to soybean production results in a structural change in labor use but

does not reduce the problem of seasonal demand and unemployment.

- 7) Livestock production under improved summer and winter pastures is characterized by greater round the year employment and reduced seasonality in the pattern of demand for labor.
- 8) Total demand for working capital and credit is insensitive to short run changes in wheat prices, but the demand declines somewhat in the long run.
- 9) The internal rate of return suggests that credit is a substantially underpriced resource, and interest rates could be raised substantially without affecting the present rate of borrowing.

#### Further Research

The following items should be included in an agenda for further research:

- 1) The possibility of reducing the wheat support prices and the substitution of livestock production on improved pasture should be more fully investigated. These alternatives should include the investigation of export possibilities of Brazilian beef to earn foreign exchange to import total Brazilian wheat requirements.
- 2) Since it is evident that at current levels of productivity domestic wheat prices cannot be substantially reduced and still maintain production, the feasibility of increasing wheat yields should be investigated.
- 3) Since the current analysis is for a representative farm size and since the farm size issue is of some importance in Southern Brazil the analysis could be extended to include

various farm sizes to see the differential impact of price changes.

PROJECT NO. 5

TITLE: "A Recursive Linear Programming Model of Agricultural Development in Southern Brazil"

STATUS: conceptualization and early model testing

TENTATIVE COMPLETION DATE: July, 1972

PUBLICATIONS: none

PRINCIPLE INVESTIGATORS: I. J. Singh and C. Y. Ahn

PROGRESS REPORT:

The purpose of this study is to develop a dynamic regional model that will explicitly include 1) technological change, 2) resource allocation, and 3) alternative agricultural programs and their effectiveness in agricultural regions of Southern Brazil in order to analyze a) support price policies, b) the introduction of new technologies in the form of both new varieties and fertilizer use as well as mechanization and c) regional credit programs and their effectiveness. Initial development will focus on wheat and livestock enterprises. Motivation is provided by the fact that domestic wheat production subsidies are to be gradually reduced as new, high-yielding varieties are developed. With the development of new high-yielding varieties that require intensive fertilizer use, the question arises as to what extent changes in the support price would affect the production and profitability of wheat. Related questions concern livestock production that competes with wheat, the availability and adoption of mechanized equipment and its consequent impact upon labor use, resource allocation, farm size and farm incomes. An additional policy motivation is provided by the need to understand clearly the role of credit availability and terms upon both types of technological changes.



The methodology involves the construction of a regional programming model of alternate wheat and livestock production, consumption, and sales activities that explicitly incorporates a) the details of technological choice, b) regional availabilities of fixed, quasi-fixed, and variable resources, c) regional credit and financial constraints and d) policy parameters in the form of regional support prices. After an initial static one-year model, the dynamic elements will be introduced through a recursive feedback in the constraint set. The model will be tested against available data and policy alternatives analyzed through parametric programming. A second stage in the project involves incorporating regional "behavioral" parameters and inter-regional flow constraints. As the model is tested and refined, additional enterprises and/or regions will be incorporated.

Much of the early work on the model has been concerned with familiarization with the MPS 360 system on the IBM at O.S.U., and in getting ready to develop a theoretical framework within which to analyse the data. The following specific progress can be reported:

- 1) Experience with the running of the wheat policy model brought out specific features of importance such as farm size that are now being considered for incorporation into the regional study. The study will now attempt to explicitly incorporate subsistence, medium size and large farms in the planalto media and missoes regions of Southern Brazil.
- 2) With the farm size issue in view a research proposal paper entitled "A Dynamic Regional Model of Interfarm Production and Capital Formation: An Application of Recursive Programming Techniques to Southern Brazil" has been written by Mr. C. Y. Ahn and distributed for discussion in the department. Mr. Ahn will be writing his Ph.D. dissertation on this topic. In the paper Mr. Ahn explicitly examines a model that incorporates different farm sizes in

a regional model through the decomposition principle. The importance of farm size issues include the problems of economies of scale with regard to machine operations, and the differential rates of investments among farms; the ability of large farms to generate larger gross sales and hence cash flows that gives them a greater access to modern inputs and credit; the differential rates of access to markets and hence rates of commercialization between farms in the region and the differential rates of adoption of new technologies that characterize the transitional phase between the current and the modernized stages in regional development. The inclusion of farm size also allows a reduction in aggregation bias that has been one of the problems associated with such regional studies to date.

3) Since the dynamic analysis of regional agricultural development requires time series data on several exogenous and endogenous variables, the task has been time consuming. The data has been partially collected and includes time series on all input and output prices for both commodities and investment goods and variable inputs. However, a large amount of the time series data still remains to be collected.

4) This summer is being spent by Mr. Ahn at the University of Wisconsin under an exchange program of graduate study between Ohio State University and the University of Wisconsin. While at Wisconsin, he will work on the theoretical framework of the study and consult with staff members there. Initially, work has begun on a heuristic dynamic model that incorporates three farm sizes and investigates the importance of differential cash flows among them and their impact upon production, rates of investment and resource allocation. The model is being run under a Recursive Decision Systems Processor available at the University of Wisconsin under the direction of Professor G. Mueller, Visiting Assistant Professor of Economics from the Institute of Agricultural Economics, University of Gottingen, West Germany.

It is hoped that initial results of this small model will be available before the end of the summer.

PROJECT NO. 6

TITLE: "An Analysis of Capital Formation Patterns of Farms  
in Southern Brazil"

STATUS: Preliminary Data Analysis

TENTATIVE COMPLETION DATE: July, 1972

PUBLICATIONS: None

PRINCIPLE INVESTIGATORS: Roger L. Baur and Norman Rask

PROGRESS REPORT:

The basic objective of this study is to determine and describe the process of capital formation at the farm level in Southern Brazil. The specific objectives are:

- 1) to identify and determine the relative importance of various factors that are significantly important in the capital formation process on various types of farms by using an appropriate measure(s) of capital formation,
- 2) to identify the sequential steps in which these significant factors were acquired during the process of capital formation,
- 3) to identify differences in the sequential pattern of acquisition among various types of farms, and
- 4) to identify various determinants that influence the capital formation process.

Initial analysis to test methodological procedures will utilize a subsample of various sized wheat and non-wheat farms selected from a larger sample of farms interviewed in Lajeado, Carazinho, and Nao-Me-Toque in

the state of Rio Grande do Sul and Concordia in the state of Santa Catarina.

Subsequent analysis will consider additional geographic areas and farm types.

PROJECT NO. 7

TITLE: Small Farmer Credit Use in Southern Brazil - 1965-1971

STATUS: Field Research underway

TENTATIVE COMPLETION DATE: July, 1972

PUBLICATIONS: None

PRINCIPLE INVESTIGATORS: Gerald Nehman and Dale Adams

PROGRESS REPORT:

A questionnaire has been designed and field tested. Approximately 150 farms in the central area of the state of São Paulo were interviewed in mid-July, 1971. About half of these farms were reinterviews of farms surveyed in 1965. Six students and several staff members of ESALQ helped with the field work.

PROJECT NO. 8

TITLE: Capital Formation on Small-to-medium sized Farms in  
Southern Brazil, 1965-1969

STATUS: Data analysis is underway, and about one-half of study  
has been written up in draft form

TENTATIVE COMPLETION DATE: September, 1971

PUBLICATIONS:

Research Notes

No. 5 - Adams, Dale W, and Joseph L. Tommy, Credit - Brazil,  
April, 1971.

No. 8 - Adams, Dale W, William Simpson and Joseph Tommy,  
Credit - Brazil, June, 1971.

PRINCIPLE INVESTIGATORS: Joseph Tommy and Dale Adams

PROGRESS REPORT:

The main objective of this study is to document the capital base and credit use of a sample of small-to-medium sized farms in Southern Brazil from 1965 to 1969. The study is based on 289 farm interviews done in 1965 and 1969. All farms were located in the states of Rio Grande do Sul and Santa Catarina.

To date work has focused mainly on documenting changes in credit use among these farmers over the 1965 to 1969 period. The analysis has shown that the substantial increase in institutional agricultural credit in Brazil has apparently gone to a rather narrow group of farmers. Further analysis of growth in the capital base of these farms, plus factors which explain capital growth are currently underway.

PROJECT NO. 9

TITLE: Comparison of Capital Formation on São Paulo Farms  
According to Size and Type of Farming

STATUS: Data organization, editing and formulation of  
analytical methods

TENTATIVE COMPLETION DATE: December, 1971

PUBLICATIONS: None

PRINCIPLE INVESTIGATORS: Ivan Garcia and Kelso Wessel

PROGRESS REPORT:

The project will be focusing on the form and extent of capital build-up on farms in the São Paulo region. Of primary interest will be an analysis of whether capital formation is occurring among all economic classes and types of farms.

Analysis will be made by sorting the 383 farms into five types of farming:

- 1) Cash annual crop - more than 50% of cultivable land in  
cotton, rice, corn or soybeans
- 2) Perennial crop - more than 50% of cultivable land in coffee  
or sugar cane
- 3) General crops - more than 50% of cultivable land in other  
crops
- 4) Cattle - more than 50% of income from livestock
- 5) Cattle and crops - none of the above hold

Following this, each of the above types of farming will be divided into small, medium and large holdings. The analysis of different forms of capital formation will be based on this 3 X 5 matrix.

PROJECT NO. 10

TITLE: "The Degree of Readiness for Innovative Adoption Among  
Farmers in Southern Brazil"

STATUS: Review of existing data

TENTATIVE COMPLETION DATE: Winter, 1972

PUBLICATIONS: None

PRINCIPLE INVESTIGATORS: Demissie G. Michael and  
David G. Francis

PROGRESS REPORT:

Objectives:

1. To compare the changes that have occurred in the rate and patterns of the adoption of new farm technology in four municipios, two each in the states of Rio Grande do Sul and Santa Catarina, in the period between the years of 1965 and 1969. If time permits, the same approach will be used for some municipios of São Paulo for the years of 1969 and 1971.

2. To relate and analyze these changes with the nature of the farm (size and type), personal data of the farmer (age, education, family size, and aspirations), and structural factors (agricultural service, community setup, banking facilities, and price policy).

3. To separate farmers and farm groups on the basis of the adoption and use of technology to improve their productive capacity and farm income, and to identify the factors responsible for the differences noted.

PROJECT NO. 11

TITLE: "Individual Characteristics and Community Factors as Predictors of the Adoption of New Ideas and Practices Among Farmers in Brazil"

STATUS: Currently in process of finalizing project proposal

TENTATIVE COMPLETION DATE: March, 1972

PUBLICATIONS: None

PRINCIPLE INVESTIGATORS: James L. Gingerich and  
David G. Francis

PROGRESS REPORT:

The primary objective of this research will be to isolate those variables or groups of variables which contribute most directly to the adoption of new ideas in the agricultural sector. Data previously collected for the Capital Formation Project will be used. The exact sample has not yet been determined.

Individual adoption scores formulated from a series of appropriate innovations will be correlated with variables at three societal levels: individual, community, and structural. A program of factor analysis will subsequently be used to extract factors which identify different types of farmers and indicate their interest in the adoption of innovations.



PROJECT NO. 12

TITLE: An Examination of Sociological Variables Related to  
Capital Formation in a Brazilian Situation

STATUS: Project development

TENTATIVE COMPLETION DATE: Fall, 1972

PUBLICATIONS: None

PRINCIPLE INVESTIGATORS: Solon J. Guerrero and  
David G. Francis

PROGRESS REPORT:

This study investigates the relationships between sociological variables which can generally be placed under the titles of: structural differentiation, community solidarity, and power structure; with the dependent variable, individual capital formation.

Tentative hypotheses include:

1. The higher the level of structural differentiation (including economic infrastructure), the higher will be the indicator of individual capital formation.
2. The more vertically oriented the leadership in the community, the less capital formation will be produced on the farms.
3. The higher the level of community solidarity among the farmers, the more new capital they will produce on their farms.

It is planned that data be collected in the Ribeirao Preto region among the sample populations interviewed by the project in 1969 and 1970. Indices of capital formation are already available from these respondents leaving only the sociological data to be collected.

PROJECT NO. 13

TITLE: Input Productivity and Productivity Change of the Crop Enterprise in Southern Brazil

STATUS: Study Completed. Manuscript in preparation

TENTATIVE COMPLETION DATE: December, 1971

PUBLICATIONS:

Steitieh, Akram Mustafa, "An Analysis of Input Productivity and Productivity Change on Crop Enterprise in Southern Brazil," Ph.D. Thesis, Dept. of Agri. Economics and Rur. Sociology, The Ohio State University, 1971.

PRINCIPLE INVESTIGATORS: Akram Steitieh and Francis Walker

PROGRESS REPORT:

The general objective of this study was to analyze input productivity and productivity change on crop enterprises in Southern Brazil in the two production periods, 1965 and 1969, and provide information that may be helpful in resource allocation to increase crop production. Two cross-sectional samples of 150 farms in 1965 and 184 farms in 1969 were used in this study. Each sample in each year was divided into three groups (subsamples) based on machinery use: a subsample that owned mechanized equipment; another that rented machinery, and a third that did not use machinery in crop production. The specific objectives of this study were: (1) to estimate and examine the value of marginal product of inputs in each group; (2) to examine input productivity change over a five-year period, 1965-1969; and (3) to estimate the elasticity of substitution of labor for other factors.

To estimate and analyze input productivity in the three subsamples, Cobb-Douglas production functions and least square regression technique were chosen for the estimation and analysis. Marginal return

of each variable was derived for economic interpretation. The working assets represented the flow of services of machinery on mechanized farms, and amount of machinery rent paid on non-mechanized farms.

A group of mechanized farms provided custom machinery services to other farms. It had higher production per hectare than a similar second group although both were investing approximately the same amount of operating expenses and working assets per hectare. In addition, the marginal return of working assets in the first group was greater than one. This was the result of better management on farms in this group. It was concluded that good management should go hand in hand with farm mechanization to insure higher crop production.

The working assets variable representing machinery rent was significant in explaining output variation with a marginal return greater than one. It was concluded that machinery renting should be encouraged where its use is topographically feasible.

The marginal return of land on the mechanized farms was higher than that on the non-mechanized. This was mainly the result of double cropping practices more common on the first group, where two crops were raised on the same land in a production period, facilitated by the presence of machinery on these farms. It was concluded that double cropping practices should be increased in area as well as in number of farms, with more supply of machinery services to achieve this goal.

Input productivity change was tested using a Cobb-Douglas production function and two techniques: Dummy Variables in the regression

model and Residual Sums of Squares. The tests showed no statistically significant increase in input productivity over the five-year period. This was the result of no substantial increase in the use of inputs, such as fertilizer, lime, new varieties of seed and insecticides and the failure of the farmer to adopt new techniques of production. It was concluded that farms should use more of these inputs, with supplied information on the right amount, appropriate time and method of application.

The elasticity of substitution of labor for other factors was estimated by three functional relationships derived from the Constant Elasticity of Substitution production function and by orthogonal regression. There was a wide range in the values of the estimates because of the different underlying assumptions in each relationship. No conclusion was reached as to the true substitution relationship between labor and the other factors.

In summary, the results demonstrate that good management, more supply of machinery services and more investment in operating expenses are expected to increase crop production on farms in Southern Brazil.

PROJECT NO. 14

TITLE: "Consumption - Investment Behavior and Savings Potential  
in Rural Areas of Brazil -- 1965-1969."

STATUS: Data analysis

TENTATIVE COMPLETION DATE: December, 1971

PUBLICATIONS:

Rask, Norman, and E. Wayne Denney, Rural Savings - Brazil,  
Research Note No. 6, The Ohio State University,  
October, 1971.

Denney, E. Wayne, "An Analysis of Income, Consumption, and  
Savings Potential at the Farm Level in Southern Brazil."  
M.S. Thesis, Department of Agricultural Economics and  
Rural Sociology, The Ohio State University, 1970.

PRINCIPLE INVESTIGATORS: Norman Rask and E. Wayne Denney

PROGRESS REPORT:

The main purpose of this study is to investigate the savings potential being generated on selected farms in Southern Brazil. The central hypothesis is that the introduction of new and profitable technologies has dramatically changed the savings-investment picture on farms in Southern Brazil. With an expected lag in consumption response, the increased income generated from the employment of new technology can serve as a pool of surplus capital to fuel further expansion in the productive capacity of agriculture. The specific objectives are:

- 1) To determine the functional relationship between consumption and income for farms of various sizes,
- 2) to describe the investment patterns of farms at different income levels, and
- 3) to measure the potential for rural savings both internal and external to the farm.

The data is drawn from two sets of farm-level surveys carried out in several farming regions of Southern Brazil. This area has experienced a revolution in the use of many forms of modern technology during the past decade. The farm-level data was collected for the calendar years 1965 and 1969 in the southern two states of Rio Grande do Sul and Santa Catarina. Approximately 1/3 of the observations are from the same farms in both time periods. Analysis of 821 farm records from the 1965 data is completed.

PROJECT NO. 15

TITLE: Rural Capital Formation, state of Rajasthan, India

STATUS: Data Analysis

TENTATIVE COMPLETION DATE: January, 1972

PUBLICATIONS: None

PRINCIPLE INVESTIGATORS: J. C. Kalla and Norman Rask

PROGRESS REPORT:

With the progress of the new seed-fertilizer revolution in some areas of India and Pakistan, the problem of finding sufficient capital resources for spreading the revolution over a sufficiently large part of the agricultural sector has acquired additional importance. The production, distribution and application of the new inputs -- seeds, chemical fertilizers, pesticides, irrigation facilities, better tools, etc. -- requires massive new investments. The governments in South Asia have been taxing agriculture lightly and spending about a quarter of their total developmental expenditure directly, and a lot more indirectly, on the agricultural sector. But they cannot be expected to allocate much more for agriculture without impairing the prospects of balanced growth. Therefore, additional resources for agricultural investment must be generated and mobilized within and from the agricultural sector itself. But the knowledge of the saving-investment behavior of tradi-

tional and innovating peasants is extremely inadequate. The study is a modest beginning to fill this critical gap in knowledge about an increasingly important problem.

The study concerns a cross-section study of of saving and investment behavior of peasant units in the Rajasthan region of India. A sample of 150 farmers from three villages was surveyed in great detail, to develop alternative measures of saving-investment, income and consumption, and to identify the important causal relationships between these variables.

The results of the study will be used to investigate the current controversies in the literature about the following items: minor land and irrigation improvements which do not survive more than one year; the imputation of the cost of investment with family labor; and the break-up of expenditure on family transport and construction into consumption and investment in a situation where the same vehicle or construction is used partly for both purposes.

Special attention will be given to the identification of dynamic changes in the structure of investment which follow increases in income due to new technology. Suggestions about policy measures required to encourage desirable changes will follow:

These hypotheses suggested by the available literature will be tested in the study:

- 1) That the average saving propensities of farmers are not abnormally low in comparison with non-farmers in similar income brackets.
- 2) That the availability of new, highly profitable technical inputs brings out additional saving potential. (Implicitly this means that incomes generated in traditional agriculture had been low not because savings rates were low but because savings were embodied in technically inefficient forms.
- 3) Institutional facilities to channel rural savings into productive forms are urgently needed.

PROJECT NO. 16

TITLE: Analysis of Factors Associated with Variations in Land  
and Labor Productivity in Southern Brazil

STATUS: Manuscript in preparation

TENTATIVE COMPLETION DATE: December, 1971

PUBLICATIONS:

Barranda, Nelson A., "Analysis of Factors Associated with  
Variation in Land and Labor Productivity in  
Southern Brazil," M.S. Thesis, Dept. of Agri.  
Economics and Rur. Sociology, The Ohio State  
University, 1970.

PRINCIPLE INVESTIGATORS: Nelson A. Barranda and  
Bernard L. Erven

PROGRESS REPORT:

The principle objective of this study was to determine the factors associated with variations in land and labor productivity. The specific objectives were to: 1) measure the level of average land and labor productivity of the farmers in the study area, 2) identify how various selected factors were associated with the variations in the average land and labor productivity, and 3) contrast the association of these factors with land productivity variations, to their association with labor productivity.

The data for the analysis came from a 1965 cross-sectional survey of farmers in six municipios of the two southernmost states of Brazil. The analysis was based on 544 farmer interviews. The farms were grouped by productivity levels (three levels), by farm type (seven farm types), and by geographical location (six municipios). Stepwise multiple regression techniques were used to determine the factors associated with average productivity variation. The detailed productivity variation analysis was limited to three farm types: hog, mechanized crop, and extensive crop.



Two general hypotheses were developed. The first hypothesis was that average land and labor productivity were each a function of farm business size, intensity of resource use, socio-cultural characteristics of the farmer, level of technology, and geographical location. The second hypothesis was that the manner and extent to which the various independent variables relate to labor productivity was different from the manner and extent to which they were related to land productivity.

Much variation in average land and labor productivity was found. With the farms divided into three groups by level of labor productivity, it was found that the "high" group had a level of productivity eight times higher than the "low" productivity group. The "high" land group had a productivity level 4.2 times higher than the "low" productivity group. The mechanized crop farms had a mean labor productivity level 12.27 times higher than the general crop farms, the farm type with the lowest labor productivity. The general crop farms, on the other hand, had the highest mean land productivity. It was 5.5 times higher than the land productivity of the range livestock farms, the farm type with the lowest land productivity.

Several factors were found associated with land and labor productivity variations. The factors, ordered by extent of association, were intensity of resource use, technology, size, geographical location, and socio-cultural characteristics. Intensity of resource use was the factor most consistently positively associated with both land and labor productivity variation for all three farm types. Technology was the second most important factor in explaining land and labor productivity on hog farms. Size measures were significantly associated with variations in both land and labor productivity on the hog farms, but only to land productivity on the mechanized and extensive

crop farms. Farm operators 50 years and older had higher land and labor productivities on extensive crop farms. Education was significantly related only to land productivity and only among the extensive crop farms. Geographical location was generally not associated with land and labor productivity variations.

Except for some size measures, the relationship of the significant factors to land productivity was similar to their relationship with labor productivity. On farm types where they were significant, total labor and total assets were negatively related to labor productivity while total land was negatively related to land productivity.

A major conclusion is that it is possible to increase land and labor productivity simultaneously. Intensity of resource use and technology are two factors strongly and positively related to both land and labor productivity. Both factors could be the object of government policy. Government policy geared toward wider adoption of technology and more intensive use of both land and labor, for example, by providing more machinery and equipment, livestock, and operating expenses, is suggested by this study.

## PUBLICATIONS

The following project and project-related publications have been prepared since project activities were initiated.

### Journal Articles

Adams, Dale W, "Agricultural Credit in Latin America: A Critical review of External Funding Policy," American Journal of Agricultural Economics, May, 1971.

\_\_\_\_\_, "What can Underdeveloped Countries Expect from Foreign Aid to Agriculture: Case Study: Brazil - 1950-1970." Inter-American Economic Affairs, Vol. 25, No. 1, Summer, 1971.

Rask, Norman, "The Impact of Selective Credit and Price Policies on the Use of New Inputs," Development Digest, Vol. IX, No. 2, April, 1971.

Singh, I. J., "The Transformation of Traditional Agriculture: A Case Study of Punjab, India," published in the American Journal of Agricultural Economics, May, 1971.

### Economics and Sociology Mimeographs

\*Sorenson, Donald M., Norman Rask and Francis E. Walker, "Capital Productivity on Specialized Swine Farms in Southern Brazil," Department of Agricultural Economics and Rural Sociology, The Ohio State University, ESM No. 459, February, 1971.

### Department Occasional Papers

\*Rask, Norman, "Analysis of Capital Formation and Utilization in Less Developed Countries," Terminal Report for Research Project Occasional Paper No. 4, Ohio State University, December, 1969.

\*\_\_\_\_\_, "Analysis of Capital Formation and Technological Innovation at the Farm Level in LDC's," First Annual Report for Research Project, Occasional Paper No. 14, Ohio State Univ., July, 1970.

Singh, I. J., "Tubewell Irrigation in the Punjab," Occasional Paper No. 17. Ohio State University, November, 1970.

\_\_\_\_\_, "The Strategic Details of Development, Traditional Agriculture," Occasional Paper No. 18, Ohio State University, November, 1970.

\_\_\_\_\_, "A Regional R.L.P. Model of Traditional Agriculture," Occasional Paper No. 19, Ohio State University, November, 1970.

- Johl, S. S., "Mechanization, Labor-Use and Productivity in Indian Agriculture," Occasional Paper No. 23, Ohio State University, December, 1970.
- \* Rask, Norman, "Analysis of Capital Formation and Technological Innovation at the Farm Level in LDC's," Progress Report for Research Project, Occasional Paper No. 26, Ohio State University, January, 1971.
- \* Engler, Joaquim J. de C., I. J. Singh, "Production Response to Technological and Price Changes: A Study of Wheat and Cattle Farming in Southern Brazil," Occasional Paper No. 33, Ohio State University, June, 1971.

#### Theses

- Barranda, Nelson A., "Analysis of Factors Associated with Variation in Land and Labor Productivity in Southern Brazil," M.S. Thesis, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1970.
- Denney, E. Wayne, "An Analysis of Income, Consumption, and Savings Potential at the Farm Level in Southern Brazil," M.S. Thesis, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1970.
- Rao, Bodepudi Prasada, "The Economics of Agricultural Credit Use in Southern Brazil," Ph.D. Thesis, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1970.
- Steitieh, Akram Mustafa, "An Analysis of Input Productivity and Productivity Change on Crop Enterprise in Southern Brazil," Ph.D. Thesis, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1971.
- Engler, Joaquim J. de C., "Alternative Enterprise Combinations Under Various Price Policies on Wheat and Cattle Farms in Southern Brazil," Ph.D. Thesis, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1971.

#### \* Research Notes

- No. 1, Nelson, William C., Fertilizer - Brazil, December, 1970.
- No. 2, Nelson, William C., Credit & Fertilizer - Brazil, December, 1970.
- No. 3, Nelson, William C., Fertilizer Marketing - Brazil, January, 1971.
- No. 4, Stitzlein, John, Agricultural Mechanization - Southern Brazil, March, 1971.

- No. 5, Adams, Dale W, and Joseph L. Tommy, Credit - Brazil,  
April, 1971.
- No. 6, Rask, Norman, and E. Wayne Denney, Rural Savings - Brazil,  
April, 1971.
- No. 7, Meyer, Richard L., and Donald Larson, Brazil's Program for  
Increasing Wheat Production  
May, 1971.
- No. 8, Adams, Dale W, William Simpson and Joseph Tommy, Credit - Brazil  
June, 1971.

Miscellaneous

- Souza, Eli de Moraes, John Stitzlein, et.al., "Formacao de Capital e  
Mudancas Tecnologicas ao Nivel de Empresas Rurais -- Lajeado,  
Carazinho, e Nao-Me-Toque - RS," Relatorio Descritivo  
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\* A minimum of at least 20 copies of each publication have been  
transmitted to USAID/Washington.

PERSONNEL ACTIVELY PARTICIPATING IN THE PROJECT -- 1970-1971

DAVID H. BOYNE -- Project Supervisor

B.S.	1957	Michigan State University	Dairy Science
M.S.	1960	University of Chicago	Economics
Ph.D.	1962	University of Chicago	Economics
1961-65	Assistant Professor	Michigan State University, Department of Agricultural Economics	
1965-67	Associate Professor	Michigan State University, Department of Agricultural Economics	
1967-	Professor & Chairman	Ohio State University, Department of Agricultural Economics and Rural Sociology	

NORMAN RASK -- Research Director

B.S.	1955	Cornell University	General Agr.
M.S.	1960	Cornell University	Agr. Economics
Ph.D.	1964	University of Wisconsin	Agr. Economics
1959-60	Extension Associate	Cornell University, Department of Agricultural Economics	
1962-64	Research Associate	University of Wisconsin, Land Tenure Center	
1964-65	Assistant Professor	University of Wisconsin, Department of Agricultural Economics	
1965-	Associate Professor	Ohio State University, Department of Agricultural Economics and Rural Sociology	

DALE W ADAMS -- Full Professor

B.S.	1956	Utah State University	Poultry Science
M.S.	1961	Michigan State University	Agr. Economics
Ph.D.	1964	Michigan State University	Agr. Economics
1964-66	Assistant Professor	University of Wisconsin, Department of Agricultural Economics	
1966-71	Associate Professor	Ohio State University, Department of Agricultural Economics and Rural Sociology	
1971-	Full Professor	Ohio State University, Department of Agricultural Economics and Rural Sociology	

BERNARD L. ERVEN -- Associate Professor

B.S.	1960	Ohio State University	Agr. Economics
M.S.	1963	Ohio State University	Agr. Economics
Ph.D.	1967	University of Wisconsin	Agr. Economics
1967-69	Assistant Professor	University of Wisconsin, Department of Agricultural Economics	
1969-71	Assistant Professor	Ohio State University, Department of Agricultural Economics and Rural Sociology	
1971-	Associate Professor	Ohio State University, Department of Agricultural Economics and Rural Sociology	

RICHARD L. MEYER -- Assistant Professor (In-Country Research Leader)

B.S.	1959	University of Minnesota	Mechanized Farming
M.S.	1967	Cornell University	Ag. Policy and Econ. Dev.
Ph.D.	1969	Cornell University	Agr. Economics

KELSO L. WESSEL -- Associate Professor

B.S.	1962	Purdue University	Agr. Economics
M.S.	1964	University of Connecticut	Agr. Economics
Ph.D.	1968	Cornell University	Agr. Economics
1968-	Associate Professor	Ohio State University, Department of Agricultural Economics and Rural Sociology	

Participated in OSU/AID Institution Building Contract with ESALQ in Piracicaba, Brazil, 1968-1970.

S. S. JOHL -- Visiting Professor

B.S.	1952	College of Ludhiana, India	Agriculture
M.S.	1955	College of Ludhiana, India	Agr. Economics
Ph.D.	1964	Chandigarh, India	Economics
1970	Visiting Professor	Ohio State University, Department of Agricultural Economics and Rural Sociology	

Professor and Head of Department of Economics and Sociology, Punjab University, India.

DONALD W. LARSON -- Assistant Professor

B.S.	1962	South Dakota State University
M.S.	1964	Michigan State University
Ph.D.	1968	Michigan State University
1968-69	Rural Sector Leader for marketing research project in Cali, Colombia.	
1969-70	Marketing Advisor to USAID Mission in Bogota, Colombia	
1970-	Assistant Professor	Ohio State University, Department of Agricultural Economics and Rural Sociology

I. J. SINGH -- Assistant Professor

B.A. (hons.)	1960	Delhi University	Economics
M.B.A.	1964	University of Wisconsin	Production Mgt.
M.S.	1965	University of Wisconsin	Econ. Development
Ph.D.	1971	University of Wisconsin	Economics
1969-	Assistant Professor	Ohio State University, Department of Agricultural Economics and Rural Sociology and Dept. of Economics	

DAVID G. FRANCIS -- Assistant Professor

B.S.	1958	Ohio State University	Agr. Education
M.S.	1960	Ohio State University	Rural Sociology
Ph.D.	1970	Cornell University	Development Soc.
1968-70	Teaching Assistant	Cornell University, Rural Sociology	
1970-	Assistant Professor	Ohio State University, Department of Agricultural Economics and Rural Sociology	

JOHN STITZLEIN -- Research Associate

B.S., M.S., OSU, comprehensives completed. Returned from Porto Alegre, Brazil, May, 1971.

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B.A., M.A., University of Andhra, India; OSU, completed dissertation and returned to Andhra University, India, November, 1970.



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B.S. and "Doutor," Escola Superior de Agricultura "Luiz de Queiroz"; M.S., Ph.D., OSU; Faculty Member, ESALQ; Completed dissertation and returned to ESALQ, June, 1971.

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B.S., Michigan State University, 1966; M.S., Michigan State University, 1968; OSU, comprehensives completed.

GERALD NEHMAN -- Research Associate

B.S., Rutgers University, 1964; M.S., University of Rhode Island, 1966; OSU comprehensives completed; arrived in São Paulo, Brazil, March, 1971.

Additional faculty and staff at OSU and cooperating institutions participating with the project, including student advising, field work leadership and other activities:

The Ohio State University

Dr. Francis Walker -- Professor

Dr. John Sitterley -- Professor

University of São Paulo (ESALQ), Brazil

Paulo Araujo -- Professor

Federal University of Rio Grande do Sul (IEPE), Brazil

Eli de Moraes Souza -- Professor

Atos Freitas Grawunder -- Professor

Jose Hilario Schuck -- Professor

Valter Jose Stulp -- Professor

Federal University of Santa Catarina

Carlos Gevaerd -- Professor

Federal University of Vicosa, Brazil

Dr. Kelly White -- Professor (Purdue)

H. Evan Drummond -- Graduate student (Purdue)

Dr. Helio Tollini -- Professor